REMARKS

In the Final Office Action, claims 1-20 were rejected. By the present response, claims 1 and 17 are amended. Upon entry of the amendments, claim 1-20 will remain pending in the present patent application. Reconsideration and allowance of all pending claims are respectfully requested in view of the arguments summarized below.

Rejections Under 35 U.S.C. § 103

In the Office Action, claims 1-8 and 12-16 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Fang et al., "Smoothing Random Noise from Human Head Scan Data" (hereinafter "Fang") in view of Fisher et al., "A Comparison of Algorithms for Subpixel Peak Detection" (hereinafter "Fisher"). Claims 9-11 and 17-20 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Fang in view of Fisher and further in view of Trucco et al., "Acquisition of Consistent Range Data using Local Calibration" (hereinafter "Trucco"). Applicants respectfully assert that the present invention, as recited in independent claims 1, 12 and 17 is patentable over Fang, Fisher and Trucco, alone or in combination.

Claims 1 and 12 and the Claims Depending Therefrom.

Claim 1 is amended to more clearly point out certain of the claimed subject matter. Specifically, claim 1 now recites, *inter alia*, generating a matched filter for each pixel in an image, and filtering the image with the generated matched filter along curves. The curves are either parallel or perpendicular to the orientation of respective flow fields. Similarly, claim 12 recites, *inter alia*, generating a matched filter for each pixel in an image by calculating:

(a) $v(i,j) = \sum_{R} \left(image(r) \times gaussian(r) \right)$ and

(b) $t(i,j) = \sum_{P} \left(v(p) \times gaussian(p) \right)$

for each pixel (i,j) in the image, and filtering the image with the generated matched filter. The image(r) is the image intensity value for a point on a curve R that emanates from pixel (i,j) and is always tangential to a flow field, and P is a curve that emanates from pixel (i,j) and is always perpendicular to the flow field.

The Examiner argued that the feature upon which Applicants rely (i.e, a two-dimensional locally matched filter) is not recited in the claim. Applicants respectfully submit that the "matched filter" is clearly defined in specification and should be read as such. The "matched filter" is not only two-dimensional but also separable one-dimensional non-Gaussian filters. *See* Application (in its published form, U.S. 2003/0113020 A1), paragraph 18-23 and paragraph 25.

Even in combination Fang and Fisher fail to disclose all the elements recited in independent claims 1 and 12.

Applicants respectfully assert that Fang and Fisher, alone or in combination, fail to disclose filtering with reference to flow fields via a matched filter such as one described in the present application. Further, Fang and Fisher, alone or in combination, fail to disclose identifying center of the projected laser stripes in the filtered image.

Fang fails to disclose filtering via a matched filter along curved parallel or perpendicular to flow fields.

The Fang reference discloses smoothing techniques using one-dimensional Gaussian filter applied on a one-dimensional signal. *See*, Fang, page 103, column 1, paragraph 5, and equation 2; *see* also, Fang, page 103, column 2, paragraph 1 and equation 3. Further, Fang describes a two-dimensional continuous Gaussian filter as a combination of two one-dimensional Gaussian filters that are separable and can be implemented as such on a two-dimensional signal in the vertical and horizontal directions to suppress noise. *See*, Fang, page 103, column 2, paragraph 2 and equation 4. The Examiner relies on equation 4 to support his rejection. However, Fang fails to teach,

disclose or suggest *a matched filter* of the type disclosed in the Application and recited in the claims. Applicants respectfully submit that the effectiveness of rectilinear Gaussian filter (Gaussian filter on a rectangular grid), disclosed in Fang, decreases as the orientation of the observed laser stripe differs from strictly horizontal or vertical. For non-planar surfaces, the orientation of the observed stripes will differ significantly from the vertical and horizontal orientations. Fang makes no provision whatsoever for this.

Applicants respectfully assert that in the present Application a prior knowledge regarding the type of object being imaged is assumed. Hence, the expected local orientation or flow field at each point in each image for each camera is known. Thus, the matched filter described in the present Application is constructed such that smoothing is done both parallel and perpendicular to the flow field. This is clearly not the same as simply rotating a rectilinear Gaussian filter, since smoothing is performed along curves (curvilinear surface) that are always either parallel or perpendicular to the orientation of the flow fields. The filters in the present Application are therefore matched directly to the expected laser stripes and are oriented based on knowledge of the surface.

Additionally, Applicants respectfully submit that the matched filter described in the present Application is a *two-dimensional filter generated in two passes and responsive to the original image*, or a *two-dimensional filter generated in a single pass*, or *separable one-dimensional non-Gaussian filters*. *See* Application (in its published form, U.S. 2003/0113020 A1), paragraph 18-23 and paragraph 25. Clearly, the matched filters described in the Application are not same as the one-dimensional Gaussian filter or the separable two-dimensional continuous Gaussian Filter described in Fang.

Applicants note that the other cited references were not relied upon by the Examiner for teaching such a matched filter, and indeed fail to do so. Consequently, the absence of the recited matched filter from Fang, and of filtering y specific reference (i.e.,

parallel and/or perpendicular to the flow fields), implies that any combination of Fang with the other references necessarily would not include such a filter or filtering.

Fischer fails to disclose identifying the center of the projected laser stripes in the filtered image.

Fischer discloses determining peak image position of an image line or stripe to subpixel accuracy. *See*, page 1, Abstract, and paragraph 1. Clearly, this is not same as identifying a *center* of a stripe as claimed. The Examiner stated that peak is the center, since laser stripe has a Gaussian distribution. Applicants respectfully submit that if the laser stripe is corrupted (as in the problematical cases addressed by the claimed invention), then laser stripe *will not have Gaussian distribution* at all and the peak may not be the center of the laser stripe as stated by the Examiner. The Examiner argued that Applicants perform center detection in the same manner as Fischer (i.e., by identifying peaks or maxima of a stripe) and points to paragraph 21 of the Applicants' specification. However, Applicants' fail to relate paragraph 21 of the Application (in its published form, U.S. 2003/0113020 A1) to identification of the center of the laser stripe. The paragraph states:

> [w]here R is a curve which emanates from pixel (i,j) and is always tangential to the flow field, r is a measure of arc length along curve R, and image(r) is the image intensity value for a point on curve R. The gaussian term localizes this one dimensional filter.

Accordingly, in the very cases addressed by the invention, the assumption made by the Examiner does not hold. Consequently, Fisher does not teach identifying a center of a laser stripe as claimed. Any combination proposed by the Examiner would, then, be defective in this respect as well.

Hence Fang and Fisher, alone or in combination, do not teach, suggest or disclose each and every aspect of the invention as recited in the independent claims 1 and 12. The reference therefore cannot support a *prima facie* case of obviousness of claims 1 and 12.

Claims 2-11 and 13-16 depend directly or indirectly from claims 1 and 12 respectively. Accordingly, Applicants submit that claims 2-11 and 13-16 are allowable by virtue of their dependency from an allowable base claim. Applicants also submit that the dependent claims are further allowable by virtue of the subject matter they separately recite. Thus, it is respectfully requested that the rejection of claims 1-16 under 35 U.S.C. §103(a) be withdrawn.

Claim 17 and the Claims Depending Therefrom.

Independent claim 17 recites, *inter alia*, identifying incoherent pixels or no pixels in the projected laser stripes, and determining one or more corrupted laser stripes in the image based on the identification. It should be noted that the laser stripes are projected onto the surface of an object and are therefore two-dimensional. The Fang and Fisher fail to teach, disclose or suggest identification of incoherent pixels or no pixels in the projected laser stripes, and determination of one or more corrupted laser stripes in the image based on the identification.

The Examiner relied upon Truccor to obviate the above deficiencies in the teachings of Fang and Fisher, and cited a passage from Truccor at page 3, column 2, paragraph 2 to support the rejection. However, Applicants respectfully assert that the phenomena described by Truccor in the cited passage in no way relates to determination of corrupted laser stripes based on the identification of incoherent pixels or no pixels in the projected laser stripes. In the cited passage Truccor describes the phenomena of *reflections from specular surfaces that results in spurious range values,* and thus suggests to *discard these spurious values based on certain constraints*. Clearly, this has nothing to do with identification of incoherent pixels or no pixels in the projected laser stripes and determination of corrupted laser stripes based on the identification.

The Examiner particularly relied upon a passage of Trucco at page 3, column 2, paragraph 4 to support his rejection, and stated that a technique of detecting incoherency

is described in the stated paragraph. Applicants respectfully submit that the constraint described in the stated paragraph is illustrated via FIG. 6 in Trucco. Clearly, the figure relates to the problem of spurious points and therefore spurious range values, and not the identification of incoherent pixels or no pixels in the projected laser stripes.

Though Trucco does disclose determining incoherent 3D points (range data), Applicants respectfully assert that Trucco fails to teach, disclose or suggest determining incoherent pixels or missing pixels in images of laser lines *in 2D imagery* as recited in amended claim 17. Moreover, Trucco discloses a technique of performing analysis in 3D, whereas claim 17 specifically relates to images in 2D. Thus, determining one or more corrupted laser stripes in the image would be simpler and require less computation in the present Application than that of Trucco. Additionally, there is no need to reconstruct the 3D in order to determine incoherency the two techniques are simply not comparable.

Furthermore, Trucco does not teach, disclose or suggest the use of epipolar geometry to eliminate points or the use of prior knowledge of the intended object surface as described in the present application (claims 19-20). Applicants respectfully submit that the technique described in the present Application allows one to repair data prior to 3D reconstruction. Different methods are employed when eliminating *incoherent pixels in 2D* as opposed to *incoherent range points in 3D*. The use of geometry relating to reflections in 3D is not equivalent, nor obviously extensible to epipolar geometry used in multi-camera stereo.

In other words, the techniques described in present Application look for consensus between multiple cameras. Trucco discloses a technique of reconstructing a 3D point and then determining if a point is "incoherent" based on 3D geometry. In contrast, the techniques described in the present Application determine if a point is good, bad or absent (incoherent or missing) based on epipolar geometry and multiple images, and then

perform reconstruction. Thus, the present Application altogether avoids reconstructing 3D points that would be incoherent.

Hence Fang, Fisher and Truccor, alone or in combination, do not teach, suggest or disclose each and every aspect of the invention as recited in the independent claim 17. The references therefore cannot support a *prima facie* case of obviousness of claim 17. Claims 18-20 depend directly or indirectly from claim 17. Accordingly, Applicants submit that claims 18-20 are allowable by virtue of their dependency from an allowable base claim. Applicants also submit that the dependent claims are further allowable by virtue of the subject matter they separately recite. Thus, it is respectfully requested that the rejection of claims 17-20 under 35 U.S.C. §103(a) be withdrawn.

Conclusion

In view of the remarks and amendments set forth above, Applicants respectfully request allowance of the pending claims. If the Examiner believes that a telephonic interview will help speed this application toward issuance, the Examiner is invited to contact the undersigned at the telephone number listed below.

Respectfully submitted,

Date: 4/12/2006

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Patrick S. Yoder
Reg. No. 37,479
FLETCHER YODER
P.O. Box 692289
Houston, TX 77269-2289
(281) 970-4545